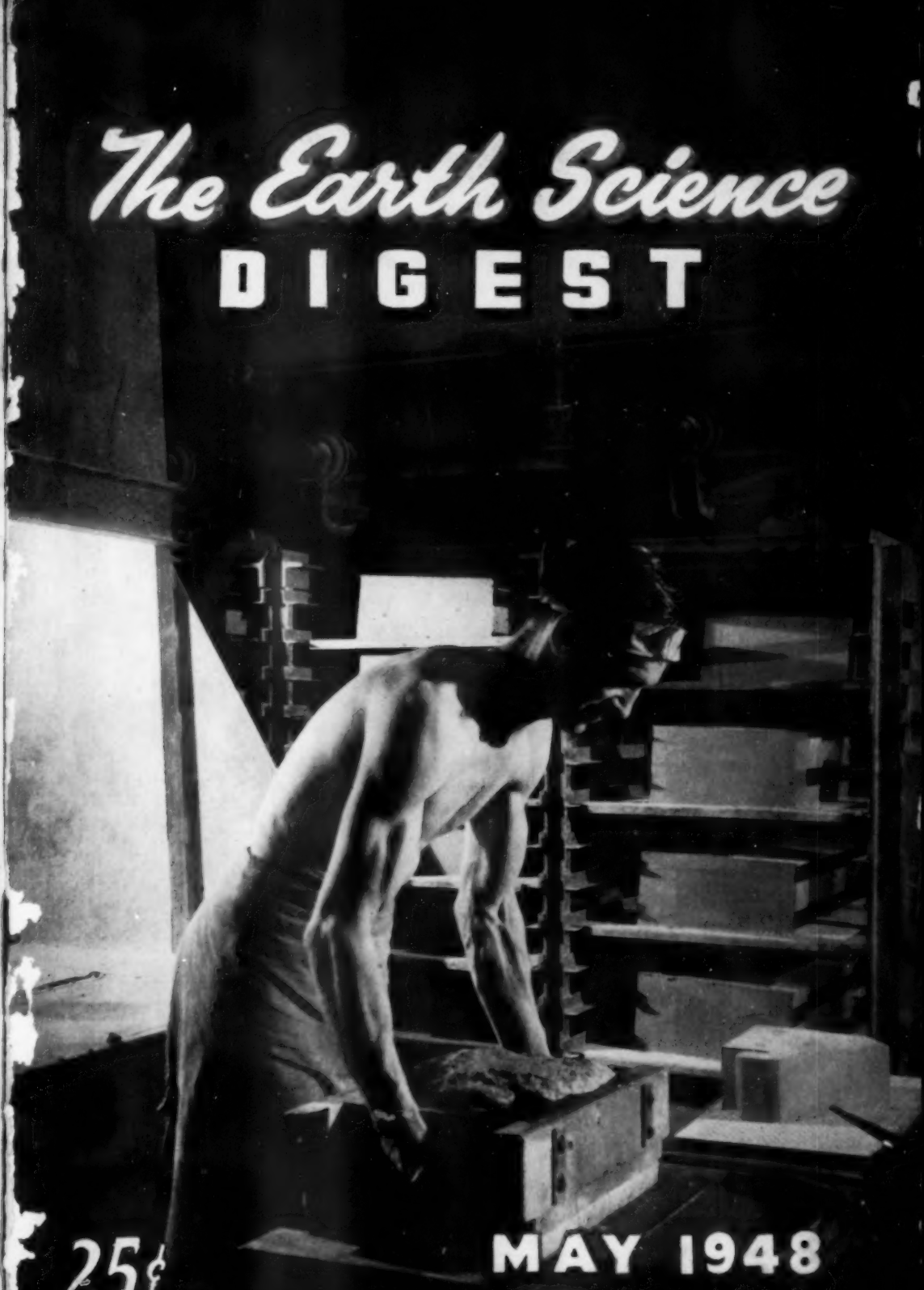
The Earth Science DIGEST



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The Earth Science Digest

Revere, Massachusetts

A magazine devoted to the advancement of the geological sciences.

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Subscriptions: 1 year, $2.00; 2 years, $3.75, 3 years, $5.00. Single Copies, 25 cents.

Published monthly by the Digest Publishers Company, 77 Victoria Street, Revere, Mass. Entered as second class matter April 12, 1948 at the post office at Boston, Massachusetts, under the Act of March 3, 1879.

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Vol. 11 MAY - 1948 No. 8

Contents

COVER PHOTO

A factory worker is shown hand molding an intricate refractory shape from a soft fire clay mud. Read the article "Fire Clay: A Strategic Earth Product" by Prof. W. D. Keller for a fascinating account of the fire brick industry. The picture was taken at the A.P. Green Fire Brick Company of Mexico, Missouri.

FIRE CLAY: A STRATEGIC EARTH PRODUCT

W. D. KELLER
University of Missouri

Fig. 1. A landscape of about 250,000,000 years ago—hills, valleys, depressions in Mississippian limestone which were filled by Pennsylvanian fire clay. The clay has been removed by mining. Mexico, Missouri.

When you fry the fish which you caught on the trip, or boil a pot of stew, you seldom give much thought to the use of the iron skillet or the iron kettle which you use to hold the food and to protect it from the fire. But did you ever stop to think or ask yourself what is the "kettle" that holds the iron when it (the iron) is melted, alloyed or smelted? Iron melts at a dazzling white heat of about 2800° F. In practice it is carried still higher to the order of 3000° F., a temperature which will fuse most of the common metals and perhaps bring about the oxidation or actual burning of them. What then is the container for iron when it is molten hot? We find it to be a special variety of naturally refined clay—fire clay. A large industry—a most fundamental industry is built about the manufacture of high temperature refractories.

During World War II quick recognition was given the oil industry, the metallurgical industries, power plants, food processing (baking and other heat processes) as fundamental and necessary industries. But in short order, it was seen that another single industry was actually fundamental and basic to even those other so-called fundamental industries. The one commodity which was absolutely necessary for all industries in order for them to enclose the heat which they required at the outset was fire brick, the most basic of all.

Large fire clay deposits of highest quality occur in Missouri and Pennsylvania with lesser development in Georgia, Ohio, and Kentucky. Indeed, Mexico, Missouri boasts of being the "fire brick capitol of the world", and certainly considerable basis for the claim is justified by the tremendous tonnage of highest quality fire brick that is shipped regularly from Audrain County, of which Mexico is the county seat, and adjoining areas. Visitors are most welcome to the factories in this community which is typically southern in its hospitality. So why not take a trip with the writer through a fire brick plant* situated right on the edge of the "fire brick capitol of the world."

* Arranged through the courtesy of the A. P. Green Fire Brick Company who advertise their plant as "being the most advanced fire brick plant in the world". Several photos were furnished by the company.

Rock and mineral collectors will be delighted to be turned loose in the clay pits and stock piles for visitors are unrestrained in picking up samples. Most of Missouri fire clay is mined from large open pits where the clay is inspected and selected for purity and grade in natural light, and where specimens are freely available. Fig. 1. shows a large open pit during production. The water-filled sump in the foreground contained 60 feet of fire clay, now removed. The irregularity of surface in the pit is due to rises or "rolls" in the flow of the deposit. These prominences are old hills of Mississippian age limestone (Burlington formation) extending up into the Pennsylvanian age fire clay which was deposited in the depressions and over the hill tops. Therefore, this picture shows the topography of early Pennsylvanian time in Missouri, a landscape of about 250 million years ago! Seldom do you see such an old landscape exhumed!

A hand specimen of typical, gray, highly slickensided plastic fire clay is shown in Fig. 2, and typical, creamy white, very pure flint fire clay is shown in Fig. 3. Note the characteristic conchoidal, flint-like fracture, although flint clay has a kaolinitic mineral composition (note the quartz or chalcedony of SiO_2 flint).

The fire clay shown in Fig. 1 was covered with 0-15 feet of Pennsylvanian shale and limestone (sometimes coal), and this was overlain with Pleistocene glacial drift that ranged up to 50 or more feet in thickness. Hence, a prospecting and geological program is carried out to find a suitable deposit before it is opened. Proving of the clay, and collection of samples for thorough analysis and ceramic testing are obtained by a power auger drill, a spud core drill, or a conventional diamond core drill.

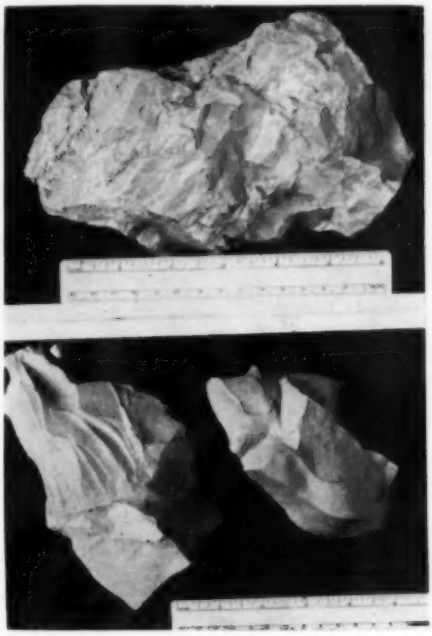


Fig. 2. Typical slickensided plastic fire clay.

Fig. 3. Typical pure flint fire clay.

Before finishing with the clays in the field, one should not neglect diaspore clay which he will certainly be shown in Missouri. Diaspore may run almost 80% Al_2O_3 (the theoretical diaspore mineral is 85% Al_2O_3, 15% H_2O, formula: $Al_2O_3 \cdot H_2O$ which is higher in alumina than bauxite, the aluminum ore. Missouri pits are the only ones in the world which produce diaspore in quantities large and pure enough to be used in commercial manufacture of refractories. Some of the associated clay contains oolites (called "burls", locally) of diaspore in a kaolinite, flint-clay-like matrix, and is called burley clay. See Fig. 4. Diaspore clay occurs in sinkhole type pits in a relatively small area south of the Missouri. The

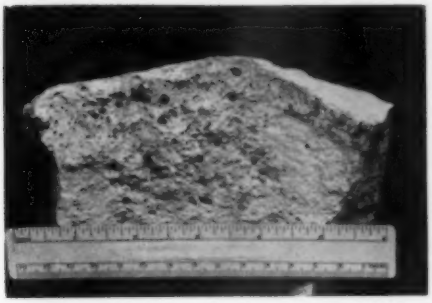


Fig. 4. Typical oolitic, burley, high alumina clay. An associate of diaspore clay.

clay is extremely resistant to fusion and is rarely melted in routine laboratory control tests because the test furnace may melt with the clay. Instead, a test is run up to about 3250°F. and if the diaspore does not show signs of melting at that temperature the fuel is shut off and the clay is approved. This illustration is given to indicate the extreme refractoriness of diaspore clay.

After the clays are hauled to the plant they are run through coarse disintegrator, and then are crushed and ground in a dry pan to small fragments which have the proper distribution of sizes of particles. The dry pan is a crusher which is adapted especially to the clay industry. See Fig. 5. Huge, heavy, steel-rimmed wheels roll over the clay on a rotating pan and the crushed clay falls through slots in the bottom of the pan. After screening out the proper sizes that clay is tempered with water so that it will maintain a cohesive shape when formed.

More fire brick are made by the dry press process than by any other. Slightly dampened clay is pressed under several thousand pounds pressure per square inch into perfectly shaped brick. This produces a brick with good all around properties.

Fig. 5 A dry pan for grinding clay.

For uses where a strong, or a relatively non-porous brick is needed to hold in hot, molten liquids (metals or slags) a stiff mud brick is employed. To produce this, clay is kneaded with water to a stiff mud which is forced out of a die, under high pressure by a screw auger, as a column of clay the size of a brick. See Fig. 6. Bricks are cut off this clay column and repressed to increase density and perfect their shape.

Where intricate shapes are needed, a softer fire clay mud is mixed and this is molded by hand from steel-lined molds to the shapes desired. See cover photo.

After the brick or shapes are formed they are slowly dried, preparatory to firing or burning. If the wet or damp brick were burned without prior drying they would explode from the steam generated inside.

The burning, or better-termed, firing process accomplishes several purposes. It shrinks the brick, it

Fig. 6. A continuous column of stiff mud fire clay being extruded under high pressure. This column moves to the left where it is cut into bricks.

bonds it into a stronger body, and it develops minerals and glass in the brick which are stable at high temperatures. To us earth scientists, the brick is thermally metamorphosed into a sort of artificial, contact metamorphic rock. A first quality fire clay develops the mineral mullite, $3Al_2O_3 \cdot 2SiO_2$, upon firing. Mullite is the name given to the mineral which was developed in naturally metamorphosed shale from the island of Mull. Hence, the mullite which is stable at high temperature gives the stability to fire brick in service. Mullite is "at home" at high temperature. It is necessary that fire clay and brick be relatively free from alkali, alkaline earth, or iron impurities in order that the fusion temperature remain high.

Firing is accomplished in a modern plant in either the older beehive shaped kilns or in the later, continuous process tunnel kilns. In tunnel kiln firing, small, narrow-gauge cars with refractory tops are loaded with brick, and are pushed, one car butting against another, through a tunnel whose midsection is kept red to white hot by fuel burners.

In Fig. 7 is seen a car of "burned" brick, almost cooled down, ready to be taken from the "finish" end of the kiln. Note the thick, refractory slab top (numbered 872 and the layer below it)

Fig. 7. A tunnel kiln car of finished, "burned" fire brick ready for service. Note car construction, and firing zone of kiln in distance.

which protects the metal work of the car from the flames that strike the brick above. In the distance, in the interior of the kiln, can be seen the dazzling brightness of the firing section. The brick on car no. 872 are stabilized mineralogically and are annealed (cooled) ready for service. They are ready to protect furnaces, ovens, or other kilns from the ravages of high temperature, slags or metals.

Where the brick are made of fire clay the stable mineral is mullite. Where the raw brick contained diaspore, that mineral has inverted to corundum, Al_2O_3, the same composition as sapphire or ruby. Diaspore brick are not synthetic sapphires 9 inches long, but the mineralogy of these two is highly similar.

Truly earth science is basic to the fire brick industry. Geology is concerned with the winning of the raw material, mineralogy embodies the raw and finished products, and microscopical petrography describes them. After the brick are laid up in the smelter furnaces, then the crude ores which the earth scientist, engineer, and miner have won from the earth are refined to the use, convenience, and pleasure of mankind.

THE BARITE GROUP MINERALS

RICHARD M. PEARL

Colorado College

A beautiful group of celestite crystals.
—Photo from Ward's Natural Science Establishment.

Four closely related sulfate minerals constitute the interesting barite group. In the order of their abundance among the minerals of the earth's crust they are anhydrite (calcium sulfate), barite (barium sulfate), celestite (strontium sulfate), and anglesite (lead sulfate). The common chemical formula that stands for all of them is RSO_4, in which R is one of the four elements mentioned above.

Since minerals are now classified according to a combination of both chemistry and crystallography, these four minerals must have a very similar structure, in addition to a similar composition, if they are to be considered as belonging to the same group. This requirement offers no difficulty for it will be found that they all crystallize in the orthorhombic system, which has three axes, all at right angles to one another and all of different lengths. Furthermore, they all belong to the same one of the 32 possible "crystal classes" which are

determined by the symmetry of the crystals. And, even more specific, the relative length of the three crystal axes are almost the same in the four minerals, as can be seen from the following "axial ratios":

Anhydrite	.8933	: 1 :	1.0008
Barite	.8152	: 1 :	1.3136
Celestite	.7790	: 1 :	1.2801
Anglesite	.7852	: 1 :	1.2894

In the study of mineralogy, metallic minerals are distinguished from nonmetallic minerals on the basis of luster, which is the appearance of the surface of a mineral in reflected light. In mineralogy, therefore, these four minerals are regarded as nonmetallic, because three of them have a vitreous (glassy) or a pearly luster; anglesite is sometimes dull, but when pure and well crystallized it has the brilliant adamantine ("diamond-like") luster so typical of nonmetallic lead minerals.

However, although none of these four minerals look like a metallic mineral, as, for example, pyrite or native silver, each contains a metallic element (calcium, barium, strontium, lead). In economic geology, therefore, where a metallic mineral is defined as one that yields a useful metal, these same four minerals might be regarded as metallic minerals, because they can be the source of a metal. Anglesite, which is a minor ore of lead is the only one to which this definition is important. The other three are used almost entirely for their physical and chemical properties rather than for the extraction of a metal, and so they are just as fully nonmetallic minerals in economic geology as they are in mineralogy.

As is true of most minerals, these members of the barite group occur more often in irregular masses without any crystal form. Anhydrite is particularly apt to be found that way. To most mineral hobbyists, however, the shining faces and symmetrical shapes of fine crystals are the most appealing part of mineral collecting. When conditions are favorable, the barite group of minerals can form so as to exhibit crystals that will please any collector. Although the chemical composition (as already discussed) is simple enough, the crystal forms are often quite complex.

Familiar to every experienced collector are the wonderful English barite crystals, the fine celestite from Clay Center, Ohio, the handsome anglesite from Scotland, and the colorful anhydrite from Lockport New York. Many more worthwhile localities could be named for each of these minerals.

Some types of occurrence, however, are a little more interesting than the average. Take, for example, celestite, the mineral pictured with this article. It is usually scattered (disseminated) through sedimentary rocks, mostly limestone and sandstone. It also occurs in pockets in such rocks. A remarkable cavern, known locally as Crystal Cave and lined with crystals of celestite, was found in 1897 on the island of Put-in-Bay, which is in Lake Erie between Detroit and Cleveland. This is not too far from the best-known American locality at Clay Center, where the celestite occurs in dolomite, filling cavities that were once occupied by fossils.

At both of these places in the Great Lakes region the celestite

was deposited later than the enclosing rock. Such deposits are called epigenetic. The strontium sulfate had been taken into solution by natural ground water during its circulation through rocks containing that compound.

Or strontium may have been furnished as some other chemical compound, which combined to form strontium sulfate when the solution containing the strontium mingled with another solution containing a sulfate or sulfuric acid. This process, like other geologic processes, is doubtless going on today in many places, and future generations of mineral collectors will revel in the beauties of celestite that does not now exist.

Strontium sulfate is known in a very different form in the shells of certain microscopic animals called radiolaria. These tiny organisms live in the surface waters of the ocean and are very numerous in the warm Pacific and Indian Oceans. Some kinds of radiolaria have shells that are almost entirely strontium sulfate. Most radiolaria, however, have shells of silica in the form of opal. When the shells sink to the bottom of the ocean they accumulate as ooze, which when hardened becomes the rock known as radiolarite. A noted deposit of radiolarite in Australia is said to contain a million shells in every cubic inch.

Celestite is deposited as an incrustation around some springs, especially in Germany and Sicily. In the latter place, celestite is associated with sulfur and gypsum, combining to form handsome mineral specimens that are preserved in many museums.

Although barite is found in many localities in a variety of colors and shapes, perhaps the most unusual occurrence from the standpoint of the mineral collector is the "barite rose" or "sand barite," which is also known under other similar descriptive names. Many thousands have been picked up in northern Oklahoma, but they are also found elsewhere in the world, including a place near Carbondale, Colorado, apparently not previously reported. These brown flower-shaped specimens are aggregates of tabular barite crystals, which have originated by sedimentary processes, whereby barite has cemented together grains of sandstone.

The most interesting occurrence of anglesite, for it indicates its origin, is likewise one of the most common ways in which it may appear. Anglesite has usually altered from galena, which is the most abundant lead mineral. The lead sulfide oxidizes to lead sulfate, which crystallizes as anglesite in cavities in the galena.

Anhydrite is so abundant and so ordinary looking that it is a little difficult to find unusual material. Some good crystals have, of course, been discovered, and some are even attractively colored. An interesting rock is sometimes created when anhydrite absorbs moisture and changes to gypsum; in so doing, it may be contorted into folds that resemble in miniature the structure of mountains. This phenomenon can be seen along the highway near Carlsbad Caverns, in southern New Mexico.

LETTERS TO THE EDITOR

The Editor
Earth Science Digest.

Dear Sir:

The writer has read numerous and universally well written articles under the titles "Lost Mines" —"Famous Lost Mines", etc., and in a recent issue of Earth Science Digest, one particularly well written, by Victor Shaw, entitled "The Lost Breyfogle". This letter is not a criticism of that article; the farthest from it; for it was very, very, interesting; but I hope for what it is worth, it will be accepted as an informative correction. And that, having to do only with the prospector's name.

I had been told in years past by two or three old time settlers of Belmont, Nevada, who knew this old time prospector very well, who found riches and then lost his mine, that his correct name was Byron W. Fogle; but he always abbreviated his signature when he had occasion to sign it at all, "By Fogle." He was known to all his friends as "By Fogle". It is evident some newspaper scribe slipped an "r" into the name in the early days, and wrote it as it sounded to him "Breyfogle", making but one word of the name and it has so remained.

As further proof of this, I enclose a photograph by the writer, and a brief description of the monument and its discovery may prove of interest to readers of the *Earth Science Digest*.

In September, 1940, the late Dr. C. W. West of Reno, Chairman of the Nevada State Parks Commission, and the writer, then also a member of that Commission, with our guide, made a trip in to the Forty Mile Canyon area of Southern Nevada for the purpose of exploration and of making a report

The "By. Fogle" monument

to and collaborating with the then U. S. Senator, the late James G. Scrugham, of Nevada, with the view of throwing a portion of that vast unexplored area into a National Park or Monument. Senator Scrugham had himself, previously made a very brief trip into that area. It is without doubt the one least known and least explored area in the entire United States as well as one of the most inaccessible. It is now within a U. S. Army aerial Bombing Reserve, and completely inaccessible. This is not a report on that expedition, nor is one available for publication until after such time as either our federal government or the State of Nevada has taken steps to protect from vandals objects therein that should be preserved for future generations. But to mention briefly — we confirmed the prior discovery and explored in detail an area of several square

miles where practically every basaltic boulder is covered with ancient cryptographs. We ourselves discovered a very high, large and beautiful natural bridge. Also what we named The Ceremonial Grounds of some prehistoric tribe or nation; a denuded, exfoliated slope of nearly a mile in length by several hundred yards in width, which had been laid out by carefully placed boulders into the most intricate and puzzling pathways and meanderings imaginable. What for? We did our own guessing. The rest we leave to scientists who may come after. A few miles from this, but in the same general area, out of mere curiosity we inspected a very curious rock that reminded one of a huge watch charm. This was about twenty feet or more high, and situated in a broad, sandy wash or narrow valley. It proved to be the "By.Fogle" monument. We had made an important discovery. We chalked in the weathered inscription "By.Fogle. 1863", and photographed it. We did not consider it a mineral monument at all, for it is in a non-mineralized area, but rather as a landmark for his future guidance. So far as known, we were the first and only ones thus far who have ever seen it.

Very respectfully yours,

C. C. Boak,
Tonopah, Nevada.

The Editor
Earth Science Digest.

Dear Sir:

I enjoy the Earth Science Digest and have been a consistent reader from its first issue. The only fault I can find in any way is that we need a bigger magazine.

Mrs. L. M. Shipley
Gem Village
Bayfield, Colorado

THE FATHER OF CANADAN GEOLOGY

The Story of Sir William Logan

E. J. ALCOCK
Curator, National Museum of Canada

(Part two of a two part story)

What kind of a man was he who left such an imprint on Canadian geology? His work and his organization that continued after him speak for themselves. Sidelights on his personality, however, have come from some of those who worked with him. Physically a small man, but strong, and energetic, of great charm, beloved by his subordinates and by his many friends, Logan's chief characteristic perhaps was his devotion to his duties. In the office he laboured from early in the morning until six or seven in the evening, taking no lunch, and except when he went out to dine with friends he always came back to work at night. He made a daily round of visits to every member of his staff for instruction or consultation, kept all his accounts with his own hand, carried on by longhand an extensive correspondence, plotted all his own surveys, wrote his reports and edited those of his assistants, examined all the fossils, minerals, and rock specimens collected during the year, studied the geological reports of the American state surveys and of other countries in order to correlate the Canadian work with theirs, and gave interviews to numerous visitors. For a number of years four manuscript copies of all the reports, including the annual Reports of Progress, were required, one for the Governor-General, one for the House of Assembly, one for the Legislative Council, and one for the printer, and Logan wrote out all of them in his own hand. In the field he worked even harder, if that were possible, than he did in the office. In a letter to Murray he describes his survey of the Ottawa and Mattawa Rivers: "The bearings have been taken with a theodolite, and the whole of the map has been carefully protracted in the field on drawing paper as the work went on, on the scale of one mile to an inch. Every sight in levelling, every bearing, sometimes twenty at a station, every micrometer angle, every reduction of the distance to chains and links, and every line of the protraction has been worked by my own hands. You may think, therefore, that I have been a little busy. I was up every morning at four and five o'clock to rouse my Indians (not one of whom would ever stir unless he had my special command), to be ready for an early breakfast and start. We seldom left our work until we could no longer see distinctly, and it was often one, two and three hours after midnight before my protraction was finished and I could creep into my blanket".

Logan was a bachelor, financially very well-to-do, generous in his givings, but most unconcerned about his own comfort. In the Survey's quarters on St. Gabriel Street he occupied a fairly large room on the second floor that served for office, draughting room, reception room, bedroom, and wardrobe. The one window had no curtain or screen; the floor no carpet or rug. A plain table and a cheap chair stood in the middle of the room and a common washstand with basin and pitcher in

one corner. An ingenious contraption served for bedstead and chair. During the day it stood in a corner and looked like an easy chair, but Logan was never known to sit in it; at night the caretaker of the building unfolded it revealing inside the blankets that Sir William used in camp. A long row of worn boots occupied a considerable part of the circumference of the room and field clothes hung on pegs or nails on the wall. Surveying instruments and a large collecting basket stood about or hung by straps at the back of the door. About 1860, a new feature appeared in the room. This was a slab of sandstone from Perth, Ontario, marked with crustacean trails, and so large that it almost entirely covered one end wall. Every morning Sir William would gaze fondly at this while performing his ablutions.

If Logan was unconcerned concerned about his personal apabout his comfort he was even less pearance. When he happened to come to town during the field season, he would not always put on his city clothes, but as a rule waited until he returned for the winter. About 1862, he purchased a coat of durable brownish grey Irish freize for city wear and he wore it every winter until he finally left Canada in 1874. This coat and a waistcoat with large squares formed by narrow white lines in time seemed to his staff to be part of the man himself. In the field he was even more careless about his appearance. In one of his notebooks he gives a description of himself on an occasion when he and his party stopped at the house of a settler named Barton: "We are all pretty-looking figures. I fancy I cut the nearest resemblance to a scarecrow. What with hair matted with spruce gum, a beard three months old, red, with two patches of white on one side, a pair of cracked spectacles, a red flannel shirt, a waistcoat with patches on the left pocket, where some sulphuric acid, which I carry in a small vial to try for the presence of lime in the rocks, had leaked through—a jacket of moleskin, shining with grease and trousers patched on one leg in four places and with a burnt hole in the other leg; with beef boots—Canada boots as they are called—torn and roughened all over with scraping on the stumps and branches of trees, and patched on the legs with sundry pieces of leather of divers colours, a broad brimmed and round-topped hat, once white but now no colour and battered into all shapes. With all these adornments, I am not surprised that Mrs. Barton, speaking of her children and saying that here was a little fellow, frightened of nothing on earth, should qualify the expression by adding, "but I think he's scared at you, Sir."

Many stories have come down about embarrassing situations in which Logan found himself as a result of his carelessness about his clothes, his good nature, and his absorption in his work. On one occasion after roughing it for some time in the back country he sent his assistant, as much the better dressed of the two, ahead to make arrangements at a hotel for their Saturday dinner. The assistant returned and reported favorably and the two filled in the time by examining some fossiliferous rocks nearby. After a while the hotel-keeper appeared. He looked very doubtfully at Sir William's trousers, which were tucked into a pair of rusty long boots, and then drawing the assistant aside he asked him if he wished separate tables to be set or if he would allow **his man** to eat with himself. On another occasion

while working North of Ottawa River, Sir William boarded a steamer to go to Montreal and took his place in the upper saloon. An officious cabin boy told him his place was below, and he and the stewart were about to eject him when a passenger who knew Sir William arrived and explained the situation. On still another occasion while working in the Eastern Townships he was returning to his stopping place late one evening very tired and hungry, when passing the railroad station, he came upon the wagon belonging to a tavern whose young driver was engaged in rolling a barrel that had just been unloaded from a train. He asked the latter if he might drive up to the village with him. "All right" came the reply, "as soon as I get up this whiskey barrel". The barrel was rolled up a plank into the wagon and the backboard fastened, and then the driver said, "Now, old man, jump up and sit astride of the barrel to keep it from rolling about and I'll give you a ride up for nothing." Sir William did as he was ordered and had a grand ride up town, but, as he remarked later in describing the incident, he was glad he did not meet any of his city friends while he was thus endeavoring to make himself useful. In days when the ordinary person took no interest in rocks and could not imagine why any one should, Logan's hammerings at rock exposures were often mystifying to the local people and sometimes looked upon with grave suspicion by them, and many a tale had he to relate of the occasions on which he had been taken for a lunatic.

Though devoted to his duties and studies Logan took great pleasure in the society of his friends, and when he did spare an evening from his work he was the centre of attention. He seemed to have an inexhaustible supply of amusing anecdotes and stories and often at the Survey office when he got into conversation with a congenial spirit his merry, hearty laugh would echo through the building. He enjoyed music and himself sang Scotch songs in a voice of rare sweetness. He appreciated art and his notebooks are filled with many charming sketches, which show an ability not only to bring out clearly the points he wished to illustrate but also to choose and skilfully delineate the unusual and beautiful.

It is perhaps, however, in his relations to those who worked with him that we get the best picture of the man. He tried to surround himself with the most capable men that he could secure and he did his utmost to assist them in their work and to promote their welfare in every way in his power. He took pleasure in giving the fullest credit to each and availed himself of every opportunity to speak highly, even flatteringly of them to strangers. Though he was an undemonstrative man they knew of his regard for them, and in return they gave him their most loyal support and were proud of the great respect and esteem in which their chief was held by the leaders in science of both America and Europe.

Succeeding generations of geologists of the Geological Survey of Canada, including those of the present day, though they have not known Logan personally, have

always felt in much the same way about him as did their predecessors who worked with him. The Survey club, which meets during the winter months to disucss geological questions and other matters of concern to the Geological staff, is known as the Logan Club, and in front of the geologists' office at the Museum in Ottowa is another reminder of him. This is a great boulder of Ottawa gneiss, from a formation Logan named and which he made classic by his studies. On it is a bronze plaque bearing his likeness and an inscription that reads:

SIR WILLIAM LOGAN
K.B., L.L.D., F.R.S.

1798-1873

The Father of Canadian Geology
Founder and First Director of the
Geological Survey of Canada
1842-1869

Erected by the Twelfth
International Geological Congress
Canada

MCMXIII

The Logan boulder

THE ASSOCIATION OF GEOLOGY TEACHERS

The eighth annual meeting of the Association of Geology Teachers was held at Hanover College, Hanover, Indiana, April 9th and 10th. Officers elected for the coming year were William F. Reed, Lawrence College, Appleton, Wisconsin, president; Leland Horberg, University of Chicago, Chicago, Illinois, vice president; Katherine Greacen, Milwaukee-Downer College, Milwaukee, Wisconsin, secretary-treasurer and Percival Robertson, Principia College, Elsah, Illinois, editor.

Committees were set up to (1) study geology curricula and standards, (2) promote the exchange of ideas and material, and (3) accumulate historical data on the teaching of geology in the United States.

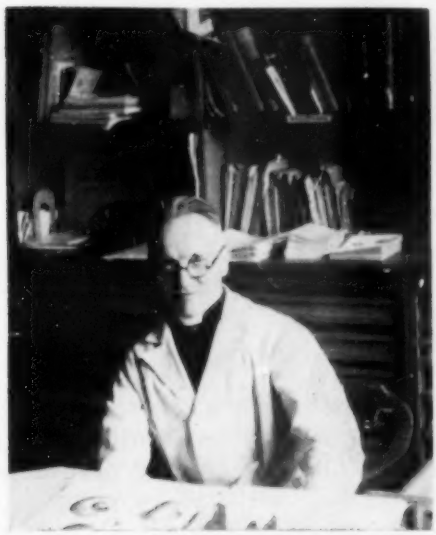
Membership in this organization is open to any teacher of geology at the college or university level. Persons interested are invited to communicate with the secretary.

Notes on the Stratigraphy and Paleontology of the Carboniferous of Belgium

HARRELL L. STRIMPLE

While stationed in Brussels, Belgium, with the Armed Services, it was possible to make a few observations on the stratigraphy and paleontology of Belgium. Extensive studies were not undertaken but it is possible those made might prove of some interest.

All work was made possible by Prof. F. Demanet, Royal Museum of Natural History of Belgium. Examination of collections in the museum proved very interesting and several important field trips were arranged by Prof. Demanet, and were conducted by one of his assistants, Mr. Josef Verbist. I would like to take this opportunity to speak briefly of personalities. It is surprising how many of the world's noted geologists are not only the possessors of brilliant minds, but also have remarkable charm and dignity.



Prof. E. Demanet at his desk in the Royal Museum of Natural History, Brussels, Belgium
—Photo by the Writer

A view of the peculiar knob-like structure found in the upper portion of the Petit Granite, Zone Tn_2b, as exposed in the Carriere (Quarry) de Hoinant, near Soignies, Belgium. There was a long erosional period and the depressions were filled with clays of the Quaternary period. The clay overburden was taken off for quarry operations, and, once again, erosion cleaned out the depressions. The writer is seen examining silicified fossil remains.

Such a man is Prof. Demanet, of small physical stature, sparkling eyes, a ready smile, and a calm dignity. Many Belgians are linguists and he was no exception, his English being excellent. A snap-shot was taken of him sitting at his desk with his cephalopod work lying about, and is reproduced herein.

Two stratigraphic charts are given, one on the Lower Carboniferous (Mississippian of American usage), the other on the Westphalien of the Upper Carbonifer-

		Belgium		Goniatites	England
LOWER CARBONIFEROUS	VISEEN	3. et de Warnant V_3	V_3c	Goniatites spiralis Goniatites subcircularis	D_2 - P_2
			V_3b	Goniatites striatus	D_2 - P_1
			V_3a	Beyrichoceras redesdalense Beyrichoceras hodderense	D_1 - P_2
		2. de Nameche V_2	V_2b V_2a	Pas de Goniatites connues	S_2 - P_1
		1. de Dinant V_1	V_1b	Pericyclus	S_1
			V_1a	Nomismoceras vittiferum Nomismoceras frechi	C_2
	TOURNAISIEN	3. de Celles Tn_3	Tn_3c	Imitoceras cotatorium	C_1
			Tn_3b	Munsteroceras complanatum Pericyclus princeps	
			Tn_3a	Munsteroceras rotella	
		2. de Maredsous Tn_2	Tn_2c Tn_2b Tn_2a	Pas de Goniatites connues	Z_2 Z_1
		1. d'Hastiere at d'Etroeungt Tn_1	Tn_1b Tn_1a	Striatoclymenia euromphala	K_2 K_1

Stratigraphic chart of Lower Carboniferous (Mississippian) formations and zones in Belgium, comparable English zones, and typical goniatites used in stratigraphic determinations. Adapted after F. Demanet.

ous (Pennsylvanian). Both charts are adapted after Prof. Demanet's work. It will be noted that a system of letters and numerals are used by the Belgians to simplify unit designations. Major divisions are shown first, ie; Tournaisien = Tn, Assise de Celles = 3, the petit Granite = b - Tn_3b. The Petit Granite is chosen for another reason; it is the principal building stone of Belgium, and on one occassion a field trip was made to their largest quarry, near Soignies. The index goniatites of the Petit Granite are given in the table but it might be noted there are other typical fauna such as the brachiopods **Productus interruptus** and **Spirifer koninckı,** and the corals **Caninia patula** and **C. cylindrica.**

Another trip was made into the Westphalien by the way of a coal mine near Mons, Belgium. This was arranged with some difficulty and probably considerable expense to some one, either the coal company or the government, because at least ten miners in addition to our two guides were held up while we worked our way through the "diggings." My view of the "Petit Buisson" (Little Coal) was one that I shall never be likely to forget. The stratigraphic position of that coal on the chart is seen as Wn_3a.

For the benefit of those who might not be familiar with fossils, the species listed under the marine phases of the Westphalien are goniatites, of the ammonite group. **Lingula** and **Orbiculoidea** are

WESTPHALIEN

Assise du Flenu	3. Zone d'Hornu - Wn_2c		Westphalien C Wn_2
	2. Zone de Wasmes - Wn_2b		
	3. Zone de Maurage - Wn_2a	Marine phase at the base of the Petit Buisson, with **Anthraconeras giranum.**	
Assise de Charleroi	3. Zone d'Eikenberg - Wn_1b	Marine zone of Lanklaar in upper part, containing **Lingula** & **Orbiculoidea.** At the base is the marine zone of Domina or d'Eysden, with **Lingula.**	Westphalien B Wn_1
	2. Zone d'Asch - Wn_1a	Marine zone of Quaregnon at the base, with **Lingula** and **Productus piscariae.**	
	1. Zone de Genck - Wn_1c	Marine zone of l'Estenaye at the base, containing **Lingula.**	
Assise de Chatelet	2. Zone superieure - Wn_1b	Marine phase of Sainte-Barbe de Floriffoux at the base with **Gastrioceras listeri.**	Westphalien A Wn_1
	1. Zone inferieure - Wn_1a	**Lingula** are present in the vien Leopold, and at the base of zone is the marine horizon of Bouxharmont, with **Gastrioceras cumbriense** & **G. crenulatum.**	

NAMURIEN

Assise d'Andenne	3. Zone de Gilly - Nm_2c	**Gastrioceras cancellatum** and **Reticuloceras superbilingue.**	

Stratigraphic table of marine horizons in the Westphalien of the Belgian Upper Carboniferous (Pennsylvanian), adapted after F. Demanet.

small, simple, tent shaped brachiopods, also distinguished in having phosphatic replacement instead of the more commonly found calcitic replacement. This type preservation gives a pearly texture and sheen, and often retains pale attractive colors. Coal itself is non-marine so the only fossils are brackish-water forms; some fish, plants, "fresh-water" clams (Pelecypods), etc.

There are always great stories under the technicalities of these studies. I wonder, for instance, how many readers would notice the cycles represented by the chart of the Westphalien. Marine zones, representing salt-water deposition, overlain by coal which represents tremendous, teeming swamps, with jungles of luxurious fern-like vegetation. Then the area submerges again and is covered over by the ocean with its calcareous deposits and marine life. It is also apparent from the fossils preserved in these marine de-

posits, and the nature of the formations, that the ocean did not become exceptionally deep in this area because deep oceans produce thick limestones and contain great varieties of sea life. Often it is possible to see evidence of an erosional period at the climax of a cycle which indicates the area involved was entirely above water for a period of time, and it is normally at such a break that major stratigraphic divisions are made. In such manner, with considerably more attention to detail of course, the geological history of our earth is compiled.

MIDWEST FEDERATION OF GEOLOGICAL SOCIETIES

The Midwest Conclave of the Federation will be held in Chicago, August 21st, 22nd, and 23rd, with the Chicago Rocks and Minerals Society as hosts. Among the events planned is a field trip to the world famous Wilmington "fern fossil hunting grounds".

Thirteen groups now make up the Federation, with a combined following of about fifteen hundred members.

The Midwest Federation recently issued an attractive 18-page Historical Number of the Midwest Geologist, the official bulletin of the organization, which featured the history of each member club. This third semi-annual number was issued under the auspices of the Joliet Mineralorist Society.

THE COLLECTOR

This section of the Earth Science Digest is devoted to the collector of minerals, fossils, and rocks. Notes on collecting, collections, localities, etc., will be welcomed. Please address all correspondence to The Collector, c/o The Earth Science Digest, Revere, Mass.

COLLECTING AT A MISSOURI SINK HOLE DEPOSIT

JAMES H. OLD

A dozen and more minerals, ranging from colorful azurite and malachite, and beautifully banded chert to drusy quartz, calcite, and dolomite may be collected from about two acres of land, near a good road, close to St. Clair, Missouri. The locality is the John Busket open pit marcasite and pyrite mine, in the extreme southeast corner of Section 28, Twp. 42N., R.1W, about two miles west of St. Clair, and about one mile north of U. S. Highway 66. The mine was abandoned because its sulfide could not compete with the shipped-in native sulfur in making sulfuric acid.

About 1880, John Busket happened upon a scanty float of limonite from this deposit. From that time, until 1936, this mine was worked sporadically, first as an iron mine, then as a sulfur mine.

This pit is a sink hole deposit measuring about 175 feet long and 100 feet wide. Since its abandonment in 1936, the pit has accumulated about 40 feet of water.

The writer, a member of an eleven student field trip, was led to this mine by Prof. N. E. Chute, then of the University of Missouri.

Several beautiful pieces of stalactitic limonite were found. One of these measured about sixteen inches in length and terminated in a rounded point. In all cases,

the soft radiating light-yellow limonite was surrounded by a hard dark-brown layer of the same material.

A mass of closely packed crinoid heads, replaced by a highly siliceous limonite, the interstices of which were composed of specularite, was found by one of the party. A like mass of crinoid heads, replaced by marcasite and surrounded by a soft yellow limonite was also found.

A large piece of red dense hematite, containing yellow chalcedony, greenish chalcedony, limonite, goethite, specularite, and pyrite was among the interesting specimens collected.

A plentiful supply of banded red, yellow, green, and brown chert, strewn over the northwest slope of the pit, will interest most collectors.

This sink hole deposit is typical of many of the southern Missouri mineral deposits. The surface country rock is lower Ordivician sandstone, the Roubidoux formation, but the sulfide deposit lies in the subjacent Ordivician dolomite, the Gasconade formation. In this deposit, the Roubidoux dips to the center at an angle of about 50 degrees in places. This is accounted for by the fact that the sink hole developed after the Roubidoux was laid down.

SOME GEORGIA LOCALITIES

On Saturday, March 27, 1948, the Georgia Mineral Society sponsored a field trip to Muscogee and Chattahoochee counties and the Fort Benning area near Columbus, Georgia. The trip was led by Prof. A. C. Munyan of Emory University and Dr. S. M. Herrich of the U. S. Geological Survey.

The party first stopped just outside of Warm Springs to gather specimens of itacolumite, which was plentiful in a road cut. The next area visited was just off the Columbus Buena Vista highway, where Opatore creek enters the Military Reservation. Here was a sand and pebble beach where silicified wood, pyritized wood, lignite, and several varieties of quartz were found. The pyritized wood and lignite was found in the creek and also along the shore. J. Roy Chapman found the prize of the day — a large section of silicified wood about 12 to 14 inches in length and tapering from about 10 inches in diameter to about 7 inches. The party had lunch along the sandy beach, and following this, Prof. Munyan took a group picture in color.

We then proceeded several miles to view two sections of silicified wood in a road cut off the main highway. The sections were approximately 5 to 6 feet in length, the smaller one being about 18 to 24 inches in diameter, and the larger one, embedded in a clay bank, several inches larger.

From this location the group went to the ASTP and Sand Hill area of Fort Benning, where very nice specimens of selenite were found in a road cut along the highway. This is the only known selenite locality in Georgia. Fossil shells were also plentiful and some appeared to be excellent polishing material.

—S. C. Knox

The BOOK SHELF

GEOLOGY

GEOLOGY by Emmons, Thiel, Stauffer, and Allison. A unique collaboration by experienced teachers, aiming to provide clearly a full knowledge of the materials of the earth, of the processes that operate at the earth's surface and that operated in the past to form the earth. 2nd ed. Illus. ..... $ 4.00

HISTORICAL GEOLOGY by Hussey. Gives the geologic history of North America throughout 2 billion years of time. The story of the development of life and the early history of man is told with a minimum of technical terms. An invaluable addition to your library. 2nd ed. Over 300 illus. ..... $ 3.75

EARTH SCIENCES by Bretz. An elementary, compact, and at the same time thoroughly interesting study of the earth sciences. An ideal book for an introductory course. ..... $ 2.50

OUTLINES OF HISTORICAL GEOLOGY by Schuchert and Dunbar. A well-organized, authoritative textbook for a brief course presenting a general survey of the history of the earth. An absence of unwieldly detail makes this book pleasant and easy reading. Fourth edition. Illustrated. ..... $ 2.75

OUTLINES OF PHYSICAL GEOLOGY by Longwell, Knopf, and Flint. This book presents the important facts and principles of physical geology in an interesting, readable manner. Illustrated. 2nd edition. ..... $ 3.00

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MINERAL COLLECTORS HANDBOOK by Pearl. A useful volume for the collector. Includes classification of the minerals and tables for gem identification. Lists mineral museums, mineralogical societies, and sources of publications on localities. 14 chapters. ..... $ 3.75

GETTING ACQUAINTED WITH MINERALS by English. A guide for beginners, students, and amateur collectors of all ages, introducing the science of mineralogy in the simplest and most interesting manner possible, without sacrificing scientific accuracy. 258 illustrations. ..... $ 2.75

THE BOOK OF MINERALS by Hawkins. This compact little book endeavors to tell the story of the important minerals and gems. Excellent photographs of many crystal forms. ..... $ 1.75

DANA'S MANUAL OF MINERALOGY by Dana. 15th edition revised by Hurlbut. Intended to meet the needs of beginning students and those who wish a concise, accurate, not too technical introduction to the study of minerals. 457 figures and plates. .... $ 4.50

DANA'S TEXTBOOK OF MINERALOGY by Dana. 4th edition revised by Ford. Contains a description of all known minerals up to 1932. A standard text on mineralogy. A "must" for the student of mineralogy and the serious collector. 1089 illus. .....$ 6.00

DANA'S SYSTEM OF MINERALOGY by Palache, Berman, and Frondel. A comprehensive revision of a classic work. Seventh edition, Volume I - Elements, Sulfides, Sulfosalts, Oxides. 1500 illustrated. $10.00

MINERALOGY by Kraus, Hunt, and Ramsdell. An introduction to the study of minerals and crystals. Over 800 excellent photographs and illustrations. .....$ 5.50

HANDBOOK OF URANIUM MINERALS by DeMent and Dake. An exposition and catalog of the uranium and thorium minerals, including methods for their detection, location and exploration. .$ 1.50

QUARTZ FAMILY MINERALS by Dake, Fleener, and Wilson. Gives both the amateur and the student definite information concerning the varieties of quartz, its location and composition, its place in history and economics, and the proper methods of cutting and polishing. .....$ 2.75

PALEONTOLOGY

INDEX FOSSILS OF NORTH AMERICA by Shimer and Shrock. This book makes it possible to turn to a single convenient volume and find illustrations and diagnoses of those fossils which can be used to identify and date formations, and to correlate them from one area to another. There are over 9,400 illustrations and more than 7,000 species are described and figured. 8" x 11". $20.00

PRINCIPLES OF MICROPALEONTOLOGY by Glaessner. An outline of micropaleontology which includes the objects and methods of micropaleontology, paleontology of the foraminifera, and stratigraphic micropaleontology. Excellently illustrated. .....$ 6.00

PETROLOGY

ROCKS AND ROCK MINERALS by Pirsonn and Knopf. A manual of the elements of petrology with the use of the microscope. A popular text used in many schools. Third edition. .....$ 4.00

GEMOLOGY

GEMS AND GEM MATERIALS by Kraus and Slawson. A comprehensive treatment of the forms, properties, formation, occurence and characteristics of gems and gem materials. Fourth edition. 344 illustrations. .....$ 3.50

THE ART OF GEM CUTTING by Dake and Pearl. Anyone who contemplates pursuing the hobby of gem cutting should have a copy of this book. It presents a wide variety of material on this fascinating hobby. Well illustrated. .....$ 1.50

REVISED LAPIDARY HANDBOOK by Howard. This book is the successor to the author's Handbook for the Amateur Lapidary. An excellent guide for the gem cutter. .....$ 3.00

The Earth Science
DIGEST
REVERE, MASSACHUSETTS

Recommended Reading

The Earth Science Digest has selected the following articles from current periodicals as recommended reading.

PHYSICAL GEOLOGY

"Geology by the Wayside". *Science Illustrated*, Vol. 3, No. 3 (March 1948), 32-37.

HISTORICAL GEOLOGY

"Dinosaurs in Our Front Yards". Horace G. Richards. *Frontiers*, Vol. 12, No. 4 (April 1948), 99-102.

"Early Man in South and East Africa". Loren C. Eiseley. *American Anthropologist*, Vol. 50, No. 1, Part 1 (January-March 1948), 11-17.

"Paleogeography of South America". L. G. Weeks. *Bulletin of the Geological Society of America*, Vol. 59, No. 3 (March 1948).

ECONOMIC GEOLOGY

"Recent Activities in Venezuela's Petroleum Industry". George S. Corfield. *Economic Geography*, Vol. 24, No. 2 (April 1948), 114-118.

GEOLOGIC EDUCATION

"Proceedings of the Conference on Training in Geology". *Interim Proceedings of the Geological Society of America — 1948*, Part 1, Report of March 1948.

"Proceedings of Joint Conference of Committee on Geologic Education and Association of Geology Teachers". *Interim Proceedings of the Geological Society of America — 1948*, Part 2, Report of March 1948.

AMERICAN FEDERATION OF MINERALOGICAL SOCIETIES

The five-page Progress Report No. 4 (April 1948) issued by Prof. Richard M. Pearl, Convention Chairman, well illustrates the excellent progress made by the Convention Committee in the past few weeks. Some of the more important announcements are given below. For further information, see page 27 of the April *Earth Science Digest* or write to Richard M. Pearl, Convention Chairman, Colorado College, Colorado Springs, Colorado.

The final program of the First National Convention of the American Federation of Mineralogical Societies will be printed in the special June Convention Issue of the *Earth Science Digest*. Thousands of copies of the *Digest* will be distributed at the Convention.

A Trading Post will be a feature of the Convention. Tables and chairs will be furnished and the facilities are free to those in attendance.

Among the many interesting items which will be on display at the Convention will be the oldest amateur gem faceting machine in the United States; the new Ward's color slides of the Harvard mineral collection; the gem miniatures carved by Lee M. Unruh of Salem, Oregon, which were shown in the Paramount film "Strange Occupations"; and some of the most outstanding collections of minerals in the United States.

A special Convention car on the Rocky Mountain Rocket will leave Chicago on June 12. Reservations for this 54-passenger chair car should be sent directly to Paul P. Christensen, Room 723, La-Salle Street Station, Chicago 5, Illinois, by May 25. No deposit is necessary. This train will go by way of Joliet, Rock Island, Iowa City, Des Moines, Council Bluffs, Omaha, and Burlington.

GEM VILLAGE

The annual Rock Show at Gem Village will be held on June 19th and 20th, 1948. Display space is free, and private exhibitors and dealers are invited to participate in the show.

Privately conducted tours will be held in the morning and afternoon of both days into the homes of the Villagers so that the private mineral collections and archeological displays of the artifacts of prehistoric man may be seen.

"The reception committee of Gem Village will assist you in making your reservations and will direct you to various points of interest, fossil fields, ancient ruins, sight-seeing trips, fishing and boating, and mineral localities in or near this area. . . . Our roads are good and the scenery is beautiful in either direction."

Gem Village is conveniently located on U. S. Highway 160, two miles west of Bayfield and eighteen mile seast of Durango, Colorado.

For further information, write to L. M. Shipley, P.O. Box 232, Bayfield, Colorado.

Planning A Trip? See the Directory

THE JUNIOR MINERAL EXCHANGE

The Junior Mineral Exchange is a non-profit association, established in 1944, dedicated to the development of interest in mineralogy and the associated sciences among the younger generation. It is now sponsored by the *Earth Science Digest*.

Membership in the Junior Mineral Exchange is open to collectors 13 to 17 years of age who desire to exchange both specimens and ideas with other collectors their age. There is a Senior Membership for older collectors.

Dues are $2.00 a year. This includes a year's subscription to the *Earth Science Digest*, a membership card, and the Junior Mineral Exchange Bulletin, the official publication of the association, issued occassionally, which contains club news and a list of the new members.

To join, send your name, address, age, and the approximate size of your collection, if any, to the Secretary:

William Tillman, 4141 Grayton Road, Detroit 24, Michigan

If you already have a subscription to the *Earth Science Digest* which has not expired, please do not enclose any dues.

The first national meeting will be held at the American Federation of Mineralogical Societies Convention in Denver, Colorado, on June 14, 1948. The place: the Shirley-Savoy Hotel. The time: 1:00 P.M. Non-members are invited to attend.

THE DIRECTORY

ARIZONA

L. E. BAGG. Arizona mineral specimens. Box 782, Peoria.

CALIFORNIA

HEALD-ROBINSON. Geologic and scenic color slides. 2202 N. Santa Anita Avenue, Altadena.

MRS. E. CAILLAND. Gem cutting material. Mineral specimens. 3642 Gerdenia Avenue, Long Beach.

THE SILVER MINE. Lapidary equipment and supplies. Books. Mineralights. 908 N. Ave 54, Los Angeles.

BURMINCO. Mineral specimens. Gem materials. Fluorescents. 128 South Encinitas, Monrovia.

GRIEGER'S. Lapidary machinery and supplies. Cut gems, gem materials. 1633 East Walnut St., Pasadena.

POLY PRODUCTS. Poly grinders. Rockhound Saw Arbors. 406 S. Chester Ct. 1C, Pasadena.

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COLORADO

THE GEM EXCHANGE. Gem cutting material and supplies. Mineral specimens. Books, magazines. Bayfield.

ECKERT MINERAL RESEARCH. Mineral specimens. Fluorescent minerals. 112 East Main Street. Florence.

NEW HAMPSHIRE

KARL A. SAHLSTEN. Rare and out-of-print books supplied. Books for collectors. Plaistow.

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ACE LAPIDARY COMPANY. Cutters of fine gems. Specializing in opals. P. O. Box 67, Jamaica.

UTAH

SUPERIOR MINERALS. Crystallized minerals and gem stones. Fluorescents. Fine jewelry. P. O. Box 248, St. George.

WYOMING

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CLASSIFIED ADVERTISEMENTS

Rate 6c per word. Minimum advertisement $1.50.

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500 WONDERFUL worldwide rock and mineral specimens. A rare bargain lot for schools, students, prospectors and collectors! Write for details. **E. R. HICKEY, Sr., 2323 S. Hope St., Los Angeles 7, California.**

25 GENUINE OZARKS, 2½" specimens, including blue, brown, and rose-green chalcedonies, red jasper, banded and mottled flints — all for cutting and polishing. Also quartz crystals and fossils. Sent postpaid for $2.00. **John Jennings, Eureka Springs, Arkansas.**

BEAUTIFUL AGATIZED WOOD from North Dakota. Assorted colors two pounds for $1.00. (Please include 30c postage). **L. Manning, Hettinger, North Dakota.**

EDEN VALLEY PETRIFIED WOOD—Limb sections ½ to 7 inches in diameter with agate markings. Cane (rare) shows leaf markings and designs. Fern Fronds, Blackwood, Palmwood, Opalized wood in several colors. Algae, black and brown. **ED SASS AND JOHN HENDRESCHKE, FARSON, WYOMING.**

NEVADA MINERAL SPECIMENS. Three sizes: small (about 1 inch)—15c, medium (about 1½ inches) — 25c, LARGE (about 2 x 3 inches) — 35c. Sizes will depend on supply and character of mineral. Everything absolutely guaranteed or money cheerfully refunded. Ask for your choice of Bornite, Barite, Calcite, Gypsum, Steatite (talc), Selenite, Petrified Wood (several varieties), Sulfur, Alum, Perlite, Pumice, Rhyolite and Wonderstone, Opalite, Quartz, Limestone, Marble, Onyx, Travertine, Ores of Manganese, Lead, Silver, Copper, or Gold. ALSO some stones for cutting, such as Agate, Petrified Wood, Jasper, Variscite, Opal, Chalcedony, Obsidian, Onyx, Wonderstone — a generous sample, 50c each kind. Write for pound prices. Also write for prices on larger sized specimens or minerals not in above list. Prices F.O.B., postage or express extra. **MRS. MARYPHYLLIS FOREMAN, BOX 178, GOLDFIELD, NEVADA.**

I HAVE ORIGINATED AND NAMED the new and fascinating CACTUS HOOK SWAN. Curio shops, get in on this. Send for prices now. If you are looking for something that will sell itself, this is it. Also have the best agate claim in America. All colors and types of moss agate. **W. W. WILKINS, Box 203, Deming, New Mexico.**

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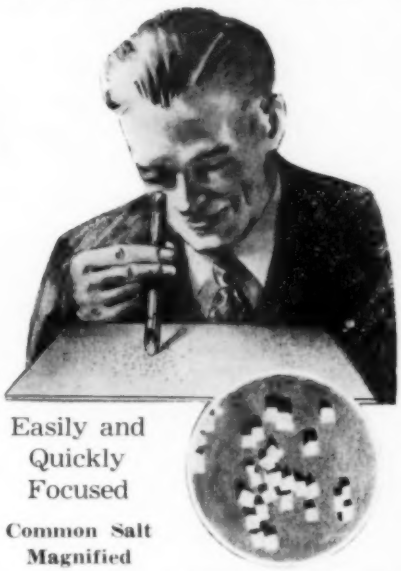

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